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Disease Detection with Molecular Biomarkers

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Description

It is possible to achieve this by monitoring biomarkers and volatile biomarkers excreted from one or more body fluids breath, sweat, saliva, urine, seminal fluid, nipple aspirate fluid, tears, stool, blood, interstitial fluid, and cerebrospinal fluid. The first section of the review provides an up-to-date list of biomarkers associated with specific illnesses and/or sampling origins. The remaining section of the review is a didactic examination of concepts and approaches related to emerging chemistries, sensing materials, and transduction techniques used in biomarker-based medical evaluations. The advantages and disadvantages of each approach are discussed and criticized. The future outlook for the information and communication era is presented and discussed.

Early and timely detection of disease biomarkers can help to prevent the spread of infectious diseases and drastically reduce the mortality rate of people suffering from diseases such as cancer and infectious diseases. Because conventional diagnostic methods are limited in low-resource settings due to the use of bulky and expensive instrumentation, simple and low-cost point-of-care diagnostic devices for timely and early biomarker diagnosis are urgently needed, particularly in rural areas and developing countries. Microfluidics technology has remarkable characteristics for simple, low-cost, and rapid disease diagnosis. Significant progress has been made in the development of microfluidic platforms for disease biomarker detection.

This review begins by introducing various microfluidic platforms (for example, polymer and paper-based microfluidics) used for disease diagnosis, followed by a brief description of their common fabrication techniques. The article then discusses different detection strategies for disease biomarker detection using microfluidic platforms, such as colorimetric, fluorescence, chemiluminescence, electrochemiluminescence (ECL) [1,2] and electrochemical detection. Finally, it discusses the current limitations of microfluidic devices for disease biomarker detection, as well as future prospects. Following a general introduction to the use of transistors for biomarker detection, a list of potentially relevant biomarkers is compiled, followed by details on the operation principles of transistors, particularly field-effect transistors.

The purpose of these devices' reliance on charged interfaces, which define the sensitive surfaces, is first explained. Then, several architectures are detailed, such as single-gate and dual-gate Ion Sensitive Field-effect Transistors (ISFETs), which allow transistors to be placed around their best operating point, resulting in improved gain and sensitivity. ISFETs and their derivatives, electric double-layer field-effect transistors (FETs), may have some disadvantages, such as high operating potentials.

Organic semiconductors perform well in this configuration, but graphene and its derivatives, despite not being semiconductors, perform well because they allow for high currents and high sensitivities, as well as excellent stability. However, the majority of these transistors are still in the research stage. Extended-gate FETs, on the other hand, are very promising devices that take advantage of existing CMOS technology by simply adding an extension to the gate contact of a commercial FET that serves as a sensing electrode. With these transistors, extreme miniaturisation is possible, and commercial applications are expected soon.

Biomarkers are nucleic acids, peptides, proteins, lipids, metabolites, or other small molecules found in human tissues or biological fluids whose accurate detection aids in disease prediction and determination. Platforms that enable the detection of important biomarkers at the point-of-care (PoC) have shifted the diagnostics field toward personalised medicine in recent years. Without a doubt, the smartphone camera is a "smart detector," and almost all optical-based methods, such as absorbance, fluorescence, and microscopic bio-imaging, have been integrated. Surface plasmon resonance [3,4] chemiluminescence, bioluminescence, and photoluminescence are all examples of luminescence. In this chapter, we will discuss how smartphones can be used as smart detectors in diagnostic devices, as well as provide an overview of recent developments in smartphone-based optical proof-of-concept devices [5].

Conflict of Interest

None.

References

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